V380 CYG: A ROSETTA STONE FOR HIGH-PRECISION MODELING OF MASSIVE BINARIES

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V380 Cyg is the bright double-lined spectroscopic eclipsing binary which properties make it an important "astrophysical laboratory" for studying the structure and evolution of massive stars. V380 Cyg consists of an evolved, more massive primary and a main-sequence secondary stars. The interpretation of the star's properties is problematic in the sense that stellar models are unable to explain the data, unless an extreme value of about 0.6 (in local pressure scale height) is adopted for the convective core overshooting parameter. The ultimate goal of this proposal is to gather sufficient Kepler data and perform an in-depth asteroseismic analysis of this important binary star system. This goal cannot be achieved by any other instrument than the currently operational Kepler space mission. Our recent investigations (Tkachenko et al. 2012) show that the application of the state-of-the-art codes to the high-quality photometric data gathered by the Kepler satellite by means of a specifically defined mask for the V380 Cyg is capable of providing a residual light curve dominated by stellar oscillations. We succeeded to detect several frequencies in the residual light curve, among which exact integer multiples of the orbital frequency. Several more frequencies are hinted at but they do not formally fulfill usually adopted significance criteria. With this proposal, we request more Kepler data to 1) detect more oscillation frequencies and to decide on the significance of the orbital frequency multiples, and 2) to prewhiten the original data with stellar oscillations signal in order to improve the orbital solution and be able to perform seismic modeling based on the residual light curve. The main reason we request one more year of observations (should the mission be not extended, six months of observations would also lead to a better frequency precision than we have now), is that we need a sufficiently long timebase to 1) better resolve the gravity mode frequencies and evaluate their stochastic nature; 2) check for the presence of low-order and medium-order pressure modes; 3) decide on the reliability of the oscillations with exact integer multiples of the orbital frequency which are presently not formally significant with the Kepler data at hand while we anticipate the important result that they are tidally induced oscillations. In the case of positive confirmation of this anticipated result, V380 Cyg will be the first high mass binary where tidally triggered oscillation are observed.